

# Fall Foliage

## Chromatography Activity

### Introduction

Illustrate that leaves contain multiple photosynthetic pigments.

### Concepts

- Chromatography
- Photosynthesis
- Chlorophyll

### Background

How do leaves change color in the fall? Across much of North America the green leaves of deciduous trees transform every autumn into various shades of yellow, orange, brown, and red. Some of these colors are observed due to pigments that are present in the leaves all year but are normally masked by chlorophyll.

Plants contain abundant quantities of the green pigments chlorophyll *a* and chlorophyll *b*. Chlorophyll *a* is the primary photosynthetic pigment while chlorophyll *b* is an accessory pigment which also absorbs light energy. Plants also contain yellow and orange pigments called carotenoids. Other carotenoids (such as beta-carotene) also capture light energy and pass it on to chlorophyll *a*.

Because chlorophyll is so abundant, leaves normally appear green. In preparation for winter dormancy, however, trees break down the chlorophyll and withdraw it from their leaves. Thus, the carotenoids are "unmasked" and the leaves appear in shades of yellows and oranges. The brilliant red colors of some species result from secondary reactions that give rise to other pigments called anthocyanins.

Paper chromatography is a technique used to separate components in a complex mixture. Separation of the pigments from a green spinach leaf gives four distinct color bands representing the following pigments:

- Carotene—yellow to yellow orange
- Xanthophyll—yellow to red
- Chlorophyll *a*—bright green to blue green
- Chlorophyll *b*—yellow green to olive

### Materials

Spinach leaf	Pencil
Fall leaves	Quarter
Chromatography paper	Ruler
Chromatography solvent	Scissors
Glass bottle or jar with lid	Tape

### Safety Precautions

*The chromatography solvent is a flammable liquid and a dangerous fire risk; it is toxic by ingestion. Keep away from flames, sparks, and other ignition sources. Wear chemical splash goggles and perform this activity in a well-ventilated lab only. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.*

## Preparation

1. Pour enough solvent into the bottle or jar so that the liquid layer is about 1 cm deep.
2. Cut a rectangle of chromatography paper so that it will just fit in and stand up inside the jar.
3. Draw a light pencil line across the bottom of the chromatography paper, about 1.5 to 2 cm above the bottom edge. The pencil line (which will become the pigment line) must be above the level of the solvent in the bottle.
4. Place the spinach leaf over the pencil line and roll a quarter over the leaf so that pigment will rub into the paper directly over the pencil line. Rub the leaf over the entire pencil line, and then air dry it for a few moments. Repeat the rolling and the drying process several times to give a thick pigment line.

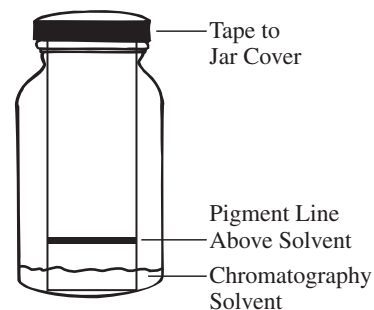


Figure 1.

## Procedure

1. Put the chromatography paper into the jar. Make sure that the pigment line is above the solvent.
2. Put the lid back on the jar. Wait approximately 30 minutes.
3. When the solvent is near the top of the paper, remove the paper from the jar and briefly air dry.
4. Observe the different color bands.
5. Repeat using different color fall leaves and compare the locations of the pigment bands and the pigment colors.

## Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. The chromatography solvent may be disposed of according to Flinn Suggested Disposal Method #18a.

## Tips

- Chromatography solvent is available from Flinn Scientific (Catalog No. C0422). Alternatively, it can be prepared by mixing nine parts petroleum ether with one part acetone.
- Clover leaves also work well in this activity.

## Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

### ***Unifying Concepts and Processes: Grades K–12***

Evidence, models, and explanation  
Constancy, change, and measurement

### ***Content Standards: Grades 5–8***

Content Standard A: Science as Inquiry  
Content Standard C: Life Science, structure and function in living systems

### ***Content Standards: Grades 9–12***

Content Standard A: Science as Inquiry  
Content Standard C: Life Science, matter, energy, and organization in living systems

## Reference

This activity was adapted from *A Demo A Day—A Year of Biological Demonstrations*, Bilash, B. and Shields, M.; Flinn Scientific: Batavia, IL (2001), pp 74–75.

## Materials for Fall Foliage—Chromatography Activity are available from Flinn Scientific, Inc.

Catalog No.	Description
C0422	Chromatography Solvent, 500 mL
AP4299	Chromatography Paper, Sheets, 100

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.